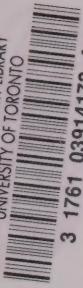


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EPIDEMIOLOGY OF DENTAL CARIES IN THE
PREMOLAR AND SECOND MOLAR TEETH IN
RELATION TO PITS AND FISSURES. 1976

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IN THE
PREMOLAR AND SECOND MOLAR TEETH
IN RELATION TO PITS AND FISSURES

by

D. W. Lewis and J. A. Hargreaves

RESEARCH REPORT

*issued by the
Dental Health Care
Services Research Unit*

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EPIDEMIOLOGY OF DENTAL CARIES
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PREMOLAR AND SECOND MOLAR TEETH
IN RELATION TO PITS AND FISSURES

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D. W. Lewis and J. A. Hargreaves

A report prepared for the
Dental Health Care Services and Epidemiology
Research Unit
Faculty of Dentistry University of Toronto
June, 1976

This project was supported in full by
demonstration model grant DM 148 of
the Ontario Ministry of Health



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ease of application, an ideal agent would be a fissure sealant which is sufficiently retained and sealed to eliminate caries from that surface.

MATERIALS AND METHODS

The dental caries surface patterns of first and second premolar and second molar teeth in 48 female and 50 male children from the Scottish Isle of Lewis at ages 11, 12, 13, 14 and 15 were determined longitudinally. The children were from the control group of a clinical trial and were present for radiographic and clinical examination each year of the trial.¹⁰ The children had relatively high caries activity but very low restorative treatment levels so that true surface caries attack was not masked. The fluoride content of their drinking water was low ($F < 0.1$ ppm). Dietary and other dental characteristics of the people on this remote island have been reviewed previously by Hargreaves.⁹

The pattern of decay experience for each of the 4 first premolars, the 4 second premolars and the 4 second molars was obtained by generating by computer a unique number for the combined surface status (sound or carious-filled) of each tooth using the original specific codes recorded for every tooth surface in the clinical trial. Patterns were calculated for each sex separately at age 11, 12, 13, 14 and 15 years. To facilitate close examination of changes between the yearly dental examinations the pattern codes were arranged in two-way transition frequency tables so that the change in state for each tooth could be followed in a longitudinal, dynamic fashion. Also by referencing the appropriate row or column

totals of these tables, the cross-sectional results at each age could be determined.

Since in this investigation 96 such two-way tables were derived, the tables are not reproduced here as in a previous report by LEWIS & HARGREAVES¹⁴ in which changes in one tooth, the first permanent molar, over three examination intervals were reviewed. Rather, selections from the two-way tables of cross-sectional data at each age and longitudinal data between ages on tooth eruption and caries activity are presented. As degrees of extent were used in the diagnosis of surface caries, some reversals did occur which can influence total numbers as shown in the tables.

Although sex differences in tooth eruption are demonstrable, data on tooth caries susceptibility for the combined sexes are used in the interest of data reduction and since the hypothetical effectiveness of fissure caries reduction on this group with nearly equal numbers of females and males is a primary question.

RESULTS

Sex, jaw and tooth differences in eruption

Eruption status by tooth, age and sex is found in Table 1. For both males and females, the upper premolars erupted prior to the lower premolars. Both upper and lower premolars erupted earlier in the females than in the males. At age 11, just over twice as many male as female first premolars were unerupted--36% of the male and 17.7% of the female first premolars, and 45.0% of the male and 21.9% of the female lower first premolars were unerupted. At age 11 males also lagged considerably behind females

in the eruption of second premolars. Second premolars tended to erupt later than first premolars for both males and females.

Since nearly all premolar teeth had erupted by age 15 for each sex, it is evident that the rate of eruption in males exceeded that of females after age 11. In first premolars this difference in rate of eruption was greatest between ages 11 and 13. As compared to first premolars the faster rate of eruption in males for second premolars was less pronounced but still evident, particularly between ages 12 to 15.

At age 11, 55.0% of the male and 53.1% of the female lower second molars were unerupted. Males and females had approximately the same rate of eruption of these teeth. For males, the lower second molars had a faster rate of eruption than the lower second premolars (from age 12 they erupted at approximately the same rate as the lower first premolars), while for the females the rate of eruption for lower second molars was approximately the same as for lower second premolars from age 12.

The upper second molars were still unerupted for 68.0% of these male and 70.8% of these female teeth at age 11. About 38% of female upper second molars erupted between the eleventh and twelfth years of age (compared to 17.0% of the males). From age 12, upper second molars erupted at approximately the same rate as lower second molars for the females while for the males, the eruption of upper second molars lagged behind that of lower second molars until age 14.

Availability of teeth for preventive treatment

Because of these differences in eruption of premolar and second molar teeth it may be useful in relation to the timing of application of preventive agents to observe how many of these teeth are erupted at each age. Early application of such agents, especially fissure sealants, is generally desirable. In the eleventh year of age or earlier, 58% of the female and 47% of male premolars and second molars were erupted. During the twelfth year of age 17.2% of the female and 15.8% of the male teeth erupted. By age thirteen 88.2% of the female and 80.9% of the male teeth had erupted. (See Table 2).

From an organizational viewpoint in a program where early protection to as many teeth as possible is desired, it would seem that at least annual applications at ages 10, 11, 12 and 13 are required to reach between 81% and 88% of premolar and second molar teeth. Further applications at age 14 and 15 would reach most of the remaining untreated teeth.

Sound teeth or newly erupted teeth remaining sound after one year

The data in Table 3 describe the number and percentage of sound teeth remaining sound from age to age (11-12, 12-13, 13-14, 14-15). Examination of such data is suggestive of which teeth require relatively earlier protection. This need, of course, is closely related to the caries activity of the six teeth. It is evident from these percentages, especially a rank ordering of them, that second molar teeth have the greatest need for caries protection followed by second premolars then first premolars. There are some

jaw differences for each tooth type. For example, with first premolars the upper has a greater need than the lower for protection and for second premolars the lower one leads the upper in this need.

To further elucidate which teeth require greater protection it is also of interest to examine caries on newly erupted teeth (Table 4). Such data indicate more dramatically early need for tooth caries protection since an age interval of less than one year is involved. The data for second molars with the sexes and ages combined demonstrate that only about 36% to 45% of erupting teeth are free of decay less than one year later (Table 4). With first premolars about 80% to 85% remain caries free while second premolars are more susceptible to decay--53% of the lower second premolars and about 70% of the uppers remaining sound.

Clearly all these teeth, and particularly the second molars and lower second premolars, require protection very soon after eruption to prevent them from becoming carious. It must be stressed that completely effective occlusal sealants would not be the sole protection required since other surfaces can decay. However the occlusal surfaces (and other fissure surfaces where applicable), as will be shown, contribute by far the greatest amount to the total number of decayed teeth, especially at ages 11, 12 and 13.

Carious tooth surface distributions and hypothetical percentage reductions

Tables 5, 6, and 7 show the status of the premolar and molar teeth at each age with the sexes combined. The distribution of carious surfaces is also given. The predominance of caries in the occlusal surface is obvious, particularly with the upper second

molars. For example at age 11, 69% to 88% and at age 13, 51% to 77% of the identifiable carious teeth have caries in the occlusal surface only, with the higher percentages in each instance being the upper second molar. At older ages caries in surfaces other than the occlusal becomes evident in all teeth but never in greater numbers than the "occlusal only" carious teeth, except for the upper second premolars at ages 14 and 15.

Using the carious surface data in these tables and the total number of decayed teeth as the controls, it is possible to calculate the hypothetical percentage reduction in caries resulting from the elimination of caries from specific tooth sites. For example, if an adhesive sealant were applied to a truly caries-free fissure surface and completely retained without leakage (or at least sufficient remnants of it were retained to protect the surface), it is assumed caries would be eliminated from that surface.

Table 8 gives the percentage reductions (coded as sealant effectiveness) for each tooth in each jaw at each age. For the second molars it is assumed that all observed lingual caries is in the lingual fissure of upper molars and that all buccal caries is in the buccal pit of lower molars. This would usually be true but exceptions would mean that these effectiveness figures for occlusal plus lingual or buccal surfaces are overstated. Extracted teeth were not included in these calculations since their carious surface distribution is not known.

The relative pattern of effectiveness of occlusal fissure sealants among the various ages is quite consistent across tooth types so it is possible to rank the overall effectiveness of

sealants for each of the teeth (Table 8). The rank order of occlusal sealant effectiveness is: (1) lower first premolar (most effective); (2) upper second molar; (3) upper first premolar; (4) lower second premolar; (5) lower second molar; and (6) upper second premolar (least effective).

The successful sealing of the lingual fissures of upper second molars and the buccal pits of the lowers adds significantly to the effectiveness percentages for these teeth (Table 8). Indeed the previously second-ranked upper second molar achieves first ranking while the fifth-ranked lower second molar rises to second place when these additional surfaces are protected.

The relationship between the hypothetical effectiveness of ideal fissure sealants for the six teeth and the caries susceptibility of these teeth is an important consideration. Relative tooth susceptibility was determined for each of the six teeth by examining the rank order of the percentage of erupted teeth which are sound (from data in Tables 5, 6 and 7), and the percentage of sound teeth (Table 3) and newly erupted teeth (Table 4) remaining sound within a one year interval. All three of these susceptibility measures gave nearly identical tooth ranks.

These susceptibility ranks and the sealant effectiveness ranks derived from Table 8 are found in Table 9. It can be seen that the tooth displaying most effectiveness using an ideal occlusal sealant (the lower first premolar) is actually the tooth least likely to decay and that the tooth demonstrating almost the least occlusal sealant effectiveness (the lower second molar) is the most susceptible tooth to dental caries. Interestingly this latter

large discrepancy in rankings disappears when the buccal pitted surface of the lower second molar as well as the occlusal is sealed (Table 9).

This comparison of ranks indicates that caries in the two most susceptible teeth of the six under study can substantially be eliminated with ideal occlusal sealant therapy if the appropriate buccal pits and lingual fissures are also sealed. The least susceptible tooth benefits highly from ideal sealant therapy simply because relatively more of its decay is in the occlusal.

DISCUSSION

For children age 10 years and above, variations in the eruption of premolar and second molar teeth between the sexes and jaws, and among different tooth types must be considered in the planning for, and administration of large scale sealant, or other, preventive programs involving direct applications to the teeth soon after eruption. In this particular sample of children applications at least annually to newly erupted teeth at ages 10, 11, 12, 13, 14 and 15 would be required. In some public programs this extended treatment regimen could become an acceptable addition to the annual recall process while in others it might be an intolerable administrative burden.

The need for caries protection also is associated with the individual susceptibility of each tooth type. Differences in susceptibility of the premolar and molar teeth to caries attack have long been recognized on the basis of both clinical and epidemiological observations.^{1,17} However, in relation to the time of

applications to prevent caries, it is particularly important to examine the rapidity of caries attack immediately after tooth eruption. In this investigation the need for early prevention is emphasised by the findings that less than one-half of the second molars erupting at a given year of age are still sound at the end of that year. With the first premolars the situation is less acute since just over 80% remain sound, while the second premolars occupy an intermediate position.

Although it cannot be demonstrated with these data from annual examinations, it is likely that the initial preventive application at more frequent than annual intervals would be necessary for the most susceptible teeth as they erupt. Under the present technology of sealant application GOING, CONTI, HAUGH & GRAINGER⁵ suggest that a six month interval to check and repair applied sealants is desirable so initial applications to newly erupted teeth could be done at this visit. Administratively, in both public programs and private practice the costs of these annual or semi-annual treatments must be considered especially with low caries susceptibility,^{13,18} which is not the case in the data being analysed here.

Since individual smooth or fissure tooth surfaces, alone or in combination, decay, it is useful to ascertain the potential reduction in caries if the most susceptible surfaces, the fissures, were rendered immune. The resulting hypothetical percentage reductions clearly demonstrate the substantial potential for caries control that sealants as applied to sound fissure surfaces and capable of 100% retention have for the premolar and second molar teeth. As children reach ages 14 and 15 years the influence of smooth surface

caries on the potential fissure caries reductions is noticeable, especially for upper second premolars, but not markedly so.

Interestingly, the potential caries reduction is greatest on the most susceptible teeth, the second molars, if their appropriate pit and fissure buccal and lingual surfaces are also sealed. These findings about the desirability to extend sealing beyond the occlusal are identical to our previous similar study using the first molars;¹⁴ however percentage reductions with only the occlusal surfaces protected are higher in the second than in the first molars. In the present study, caries in the lower second premolar would be influenced least by occlusal fissure sealants yet percentage reductions of 46% to 69% at the various ages are still possible.

It must be stressed that the hypothetical percentage reductions calculated here are based on the assumptions of early sealant application and for molars, sealant extension to fissure surfaces other than the occlusal, as well as complete retention. These assumptions ignore the actual experience of some clinical trials whereby retention has generally been disappointing and variable. Also, retention experience with premolars has been better than with molars. Going et al.,⁶ for example, showed occlusal retention to be best on the lower second premolar, the most caries susceptible premolar tooth in the present report, and worst on the upper second molar--a highly susceptible tooth but with the greatest hypothetical caries reduction potential according to our results.

Such discrepancies are disconcerting; however, it is unlikely that the technology of development of fissure sealant materials and their application methods has reached its peak. The potential with

large groups of children for caries reductions using fissure sealants especially when blended with the additive reductions of fluoride agents, which mainly influence smooth surface caries, is truly exciting to contemplate. It does remain to be seen, however, whether technological, administrative and practical problems can be overcome so that this potential is realized.

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ACKNOWLEDGMENT -- This analysis was supported in full by Demonstration Model grant D.M. 148 of the Ontario Ministry of Health.

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Table 1. Percentage of teeth unerupted*

Tooth	Age	Upper		Lower	
		Female	Male	Female	Male
		%	%	%	%
1st Premolar	11	17.7	36.0	21.9	45.0
	12	13.5	18.0	17.7	33.0
	13	5.2	6.0	6.3	16.0
	14	1.0	4.0	1.0	7.0
	15	0.0	2.0	1.0	1.0
2nd Premolar	11	39.6	56.0	49.0	58.0
	12	20.8	35.0	34.4	52.0
	13	12.5	21.0	15.6	32.0
	14	6.3	12.0	7.3	29.0
	15	2.1	4.0	1.0	3.0
2nd Molar	11	70.8	68.0	53.1	55.0
	12	32.3	51.0	30.2	34.0
	13	15.6	24.0	15.6	16.0
	14	9.4	10.0	8.3	10.0
	15	1.0	2.0	0.0	1.0

* Teeth on the right and left sides have been combined. There were 48 female and 50 male children at each age.

Table 2. Tooth eruption status summary--
premolars and second molars

Percentage of teeth erupting at various ages		
Age in years	Females*	Males*
	%	%
≤11	58.0	47.0
12	17.2	15.8
13	13.0	18.1
14	6.3	7.1
15	4.7	9.8
≥16	0.8	2.2
	100.0	100.0

* There were 48 female and 50 male children at each age. Since each child potentially has 12 premolar and second molar teeth, the percentages are based on 576 female and 600 male teeth respectively, ignoring the possibility of congenitally missing or supernumerary teeth.

Table 3. Percentage of sound teeth remaining sound after one year

Age interval	1st Premolar		2nd Premolar		2nd Molar	
	Upper s/s* %	Lower s/s* %	Upper s/s* %	Lower s/s* %	Upper s/s* %	Lower s/s* %
12/11	68/100 (68.0)	77/100 (77.0)	36/63 (57.1)	29/58 (50.0)	8/26 (30.8)	7/38 (18.4)
13/12	75/100 (75.0)	100/118 (84.7)	47/74 (63.5)	29/56 (51.8)	9/33 (27.3)	9/29 (31.0)
14/13	59/103 (57.3)	96/138 (69.6)	41/72 (56.9)	24/61 (39.3)	8/35 (22.9)	8/32 (25.0)
15/14	50/74 (67.6)	89/123 (72.4)	36/59 (61.0)	22/51 (43.1)	7/24 (29.2)	6/21 (28.6)
Totals	252/377 (66.8)	362/479 (75.6)	160/268 (59.7)	104/226 (46.0)	32/118 (27.1)	30/120 (25.0)

* s/s means the number of teeth remaining sound at the older age relative to the number of these same teeth which were sound one year previously. Thus 68/100 means of the 100 teeth sound at age 11, 68 remained sound at age 12.

Table 4. Percentage of newly erupted teeth remaining sound during a one year age interval

Age interval	1st Premolar				2nd Premolar				2nd Molar			
	Upper		Lower		Upper		Lower		Upper		Lower	
	s/u*	%	s/u*	%	s/u*	%	s/u*	%	s/u*	%	s/u*	%
12/11	23/28	(82.1)	22/24	(91.7)	31/41	(75.6)	21/29	(72.4)	21/58	(36.2)	19/51	(37.3)
13/12	18/21	(85.7)	27/30	(90.0)	18/24	(75.0)	22/39	(56.4)	19/46	(41.3)	18/35	(51.4)
14/13	3/6	(50.0)	11/14	(78.6)	12/18	(66.7)	11/17	(64.7)	10/24	(41.7)	7/16	(43.8)
15/14	2/2	(100.0)	3/6	(50.0)	6/12	(50.0)	8/32	(25.0)	2/16	(12.5)	10/17	(58.8)
Totals	46/57	(80.7)	63/74	(85.1)	67/95	(70.5)	62/117	(53.0)	52/144	(36.1)	54/119	(45.4)

* s/u means the number of teeth erupted but sound at the older age which were unerupted one year previously. Thus 23/28 means of 28 unerupted teeth at age 11, 23 had erupted and were still sound one year later at age 12.

Table 5 . Status of upper and lower first premolars* by age

Tooth status	Upper					Lower				
	Age					Age				
	11	12	13	14	15	11	12	13	14	15
Unerrupted	53	31	11	5	2	66	50	22	8	2
Sound	100	100	103	74	71	100	118	138	123	110
Carious**	38	57	72	103	108	30	27	35	64	82
Extracted-caries	1	1	2	5	9	0	1	1	1	2
Extracted-other	4	7	8	9	6	0	0	0	0	0
Totals	196	196	196	196	196	196	196	196	196	196

Carious
tooth
distribution**

Occlusal	33	46	52	60	64	27	19	27	50	55
M, D, B, MD BD, MBD	2	6	9	14	10	2	2	5	4	12
MOD, MO, DO	1	4	10	24	23	1	2	1	6	8
OB, OL	1	1	0	0	1	0	0	0	0	1
OBM, MODB, MODL, MODBL	1	0	1	5	10	0	4	2	4	6

* The sexes and teeth on the right and left sides have been combined.
There were 48 female and 50 male children at each age.

Table 6 . Status of upper and lower second premolars* by age

Tooth status	Upper					Lower				
	Age					Age				
	11	12	13	14	15	11	12	13	14	15
Unerrupted	94	55	33	18	6	105	85	47	36	4
Sound	63	74	72	65	53	58	56	61	51	45
Carious**	39	67	89	111	119	32	53	80	98	119
Extracted-caries	0	0	0	1	17	1	1	4	7	24
Extracted-other	0	0	2	1	1	0	1	4	4	4
Totals	196	196	196	196	196	196	196	196	196	196
Carious tooth distribution**										
Occlusal	27	37	45	51	55	27	40	54	63	70
M, D, MD, ML, L, B, LD	4	12	13	12	12	1	1	10	12	19
MOD, MO, DO	6	10	25	37	37	2	6	13	17	22
OB	-	-	-	-	-	1	0	0	0	2
OBM, OBD, OLM, OLD DOBL, MODL, MODB MODBL	2	8	6	11	15	1	6	3	6	6

* The sexes and teeth on the right and left sides have been combined.
There were 48 female and 50 male children at each age.

Table 7. Status of upper and lower permanent second molars* by age

Tooth status	Upper Age					Lower Age				
	11	12	13	14	15	11	12	13	14	15
Unerupted	136	82	39	19	3	106	63	31	18	1
Sound	26	33	35	24	9	38	29	32	21	13
Carious**	34	81	122	153	174	52	104	130	150	162
Extracted-caries	0	0	0	0	0	0	0	3	7	20
Extracted-other	0	0	0	0	10	0	0	0	0	0
Totals	196	196	196	196	196	196	196	196	196	196

Carious tooth distribution**

Occlusal	30	64	94	94	109	36	78	84	89	85
Mesial	1	0	0	0	0	0	0	1	0	0
L (upper), B (lower)	0	2	1	1	1	0	2	2	0	1
MOD, MO, DO	0	0	1	1	3	0	2	3	9	11
OL (upper), OB (lower)	1	12	17	36	40	12	12	21	26	30
OBM, OBL, OBD, OLD, MOL, DOBL, MOLD, MODB, OBLD, MODBL, OL (lower), OB (upper)	2	3	9	21	21	4	10	19	26	35

* The sexes and teeth on the right and left sides have been combined. There were 48 female and 50 male children at each age.

Table 9. Comparison of tooth susceptibility to caries and sealant effectiveness tooth ranks

Tooth	Caries susceptibility rank	Occlusal sealant effectiveness rank	Occlusal and buccal or lingual sealant effectiveness rank
Lower 2nd molar	1 (most)	5	2
Upper 2nd molar	2	2	1 (most)
Lower 2nd premolar	3	4	5
Upper 2nd premolar	4	6 (least)	6 (least)
Upper 1st premolar	5	3	4
Lower 1st premolar	6 (least)	1 (most)	3

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